AERONAUTICAL CHARTING FORUM
Instrument Procedures Group
October 27, 2009
HISTORY RECORD

FAA Control # 09-02-287

Subject: Operator Training Concerning One Engine Inoperative Contingency Planning For IFR Departure Procedures.

Background/Discussion:

14 CFR 91.175(f)(4)(i) states in part:

> (4) Notwithstanding the requirements of paragraph (f)(3) of this section, no pilot may takeoff from an airport under IFR unless:
>
> (i) For part 121 and part 135 operators, the pilot uses a takeoff obstacle clearance or avoidance procedure that ensures compliance with the applicable airplane performance operating limitations requirements under part 121, subpart I or part 135, subpart I for takeoff at that airport;

This rule requires commercial operators of large or turbine-powered airplanes departing an airport under IFR to have a procedure for of avoiding obstacles in the event of an engine failure on takeoff. The 27 August 2009 AIM edition refers operators to AC 120-91, *Airport Obstacle Analysis*, for guidance in developing these procedures. This AC published in 2007 and developed in cooperation with industry provides a framework meeting the one engine inoperative (OEI) takeoff obstacle clearance rules found in Subpart I, Part 121 or Subpart I, Part 135 (hereafter referred to as Subpart I).

Unfortunately in the absence of guidance prior to the AC's release, many Part 135 operators and Part 142 training centers developed ad hoc methods for takeoff obstacle avoidance based on complying with the climb gradient published on an ODP or SID using OEI performance. While on the surface, this may appear to be an acceptable procedure, this ad hoc method and others similar to it, fail to account for critical differences between the TERPS criteria, the Part 25 OEI takeoff certification rules, and the operating rules OEI takeoff obstacle avoidance contained in the Subpart I. Use of these ad hoc procedure results in many problems including:

1. Failure to base obstacle clearance on the full, complete OEI net takeoff flight path. The most widely used ad hoc method compares a particular OEI climb gradient obtained from the AFM (usually the 2nd segment OEI climb gradient) to a climb gradient published on a SID or ODP. To begin with, this method extrapolates performance data beyond the instructions and procedures provided in the AFM. Extrapolation of AFM performance data beyond the applicable procedures stated in the AFM or on the chart is not approved by the FAA.

Unlike TERPS, which bases obstacle clearance on an uninterrupted surface defined by a gradient, the Part 25 OEI net takeoff flight path is constructed from a series of synthesized segments that do not form a continuous gradient. The Part 25 OEI net takeoff flight path is evaluated against known obstacles within the lateral accountability area defined by either Subpart I or AC 120-91. Because of the segmented nature of the net takeoff flight path, comparison of a single OEI climb gradient against a TERPS gradient will not ensure obstacle clearance along the entire OEI net takeoff flight path (see fig 2)

2. Because the climb gradient often published on an ODP or SID must be maintained to a significant height above the runway elevation, the method described above often results in the operator's failure to account for the established time limit for the use of takeoff thrust. The procedures and OEI flight path charts published in the AFM ensure accountability for this limit. However, operators frequently bypass these charts in favor of comparing the OEI climb gradient to the TERPS gradient. The result is that a critical certification time limit affecting the use of takeoff thrust in the event of an engine failure on takeoff is not considered by the operator when developing the engine failure procedure.

3. Use of a TERPS gradient does not account for low, close-in obstacles described in AIM 5-2-8 (c) (1). These obstacles are critical when the aircraft does not lift off until close to the departure end of the runway or when aircraft is climbing at the minimum rate, both of which are frequently experienced with an engine failure on takeoff at or shortly after V1 speed (see Fig 3). Unfortunately, not all ODPs or SIDs note these close-in obstacles as this charting requirement was not in place prior to TERPS change 19. Therefore, an operator comparing the OEI climb gradient to the TERPS climb gradient may be missing critical obstacles at the beginning of the OEI net takeoff flight path where the available performance margin is at a minimum.

The failure to follow the procedures provided in the AFM and the guidance contained in AC 120-91 means that commercial operators following these ad hoc procedures may not be meeting their obstacle clearance obligations for departing under IFR as stated in 91.175 (f)(4).

This situation is the direct result from the absence of FAA guidance available to operators and training providers concerning the proper methods utilized in the development of OEI takeoff obstacle avoidance procedures. What may have begun as technique in the absence of FAA guidance has grown into **the** singular accepted procedure for takeoff obstacle avoidance used in the training and evaluation of non-Part 121 air carrier pilots of large, turbine-powered airplanes for FAA-issued pilot certificates, type-ratings, and competency checks conducted under Part 61 and Part 135.

Because many of the training providers involved in teaching these ad hoc methods are FAA-certificated under Part 142, and in the case of a Part 135 operator also approved by that operator's Principle Operations Inspector (POI), an aura of FAA approval and sanction have been placed upon these ad-hoc procedures. With proper guidance now available from the FAA in the form of AC 120-91 as referenced by the AIM change, further steps must now be taken to address the use and training of these ad hoc methods by Part 135 operators and by Part 142-certificated training providers.

Recommendations:

AC 120-91 provides guidance on the development of OEI contingency procedures. The methods provided in the AC were developed over many years of careful deliberation by the industry and FAA. Operators and training providers should be informed of the necessity to apply the methods contained in this AC and the procedures published in the AFM specific to the aircraft being flown when developing their OEI takeoff obstacle avoidance procedure. Operators and training providers should be further advised to refrain from using, teaching, or evaluating pilots based on the use of unapproved, ad-hoc techniques or using procedures that not contained in the FAA-approved AFM.

In support of this recommendation, NBAA request the following actions:

1. Request that the applicable FAA Flight Standards branch notify operators and Part 142 training centers of the requirement to apply the performance data provided in the AFM using the procedures specifically described within the AFM when meeting the OEI takeoff obstacle avoidance rules of Subpart I, Part 121 or Part 135 as applicable. It must be further emphasized that the use of other procedures, techniques, or other work-arounds as described above are **not** authorized unless specifically approved by the FAA. Further, Flight Standards should recommend that operators and training centers refer to AC 120-91 for guidance on OEI takeoff obstacle procedure development and alternative procedure approval.

   Since this guidance concerns regulatory compliance and safety, NBAA requests that it be published though a SAFO to all Part 135 operators and Part 142 training centers. NBAA requests that FAA ensure wide dissemination of the SAFO to all Part 142 training center program managers (TCPM), training center evaluators (TCE), directors of draining, and instructors.

2. Expand guidance provided in the Instrument Procedures Handbook on IFR departures to include a discussion on OEI takeoff obstacle avoidance planning for airplanes subject to the 91.175(f)(4) requirements with specific reference to AC 120-91.

Comments: This recommendation affects the following: FAA-H-8261-1A, Instrument Procedures Handbook;; A SAFO or InFO to operators and Part 142 Training Centers.

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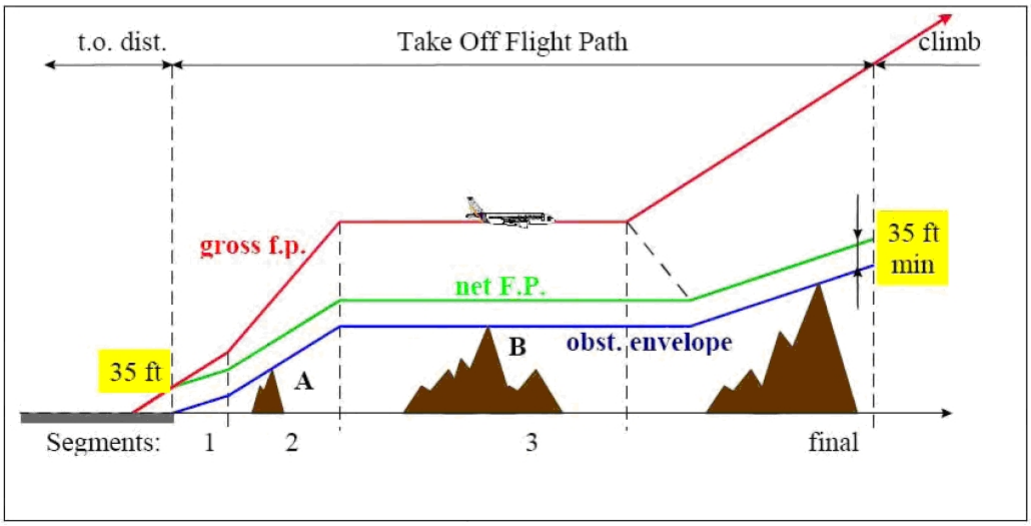
Fig #1

FAR 25 OEI Takeoff Path &
Subpart I, 121 & 135 Net Takeoff Flight Path Obstacle Clearance



TERPS Departure Obstacle Climb Requirements

Figure 1-3. Climb Segment. Par 202b.

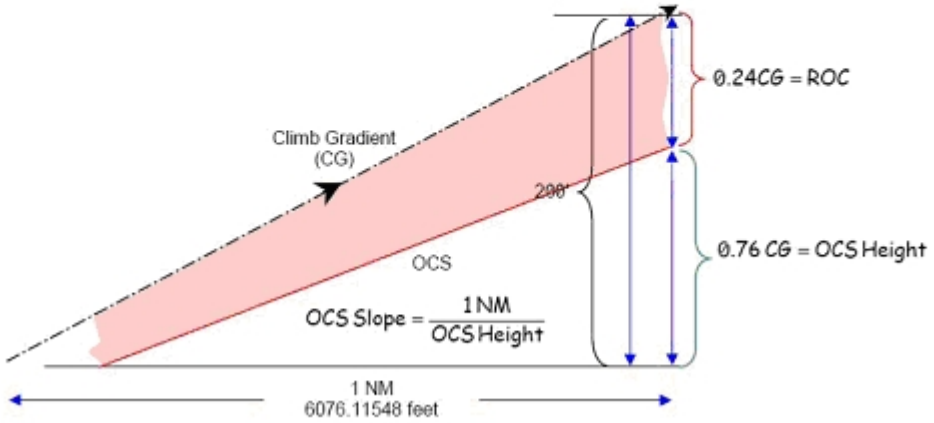


Fig 2: Comparison Between Part 121 & Part 135 net takeoff flight path obstacle clearance rules and the TERPS criteria

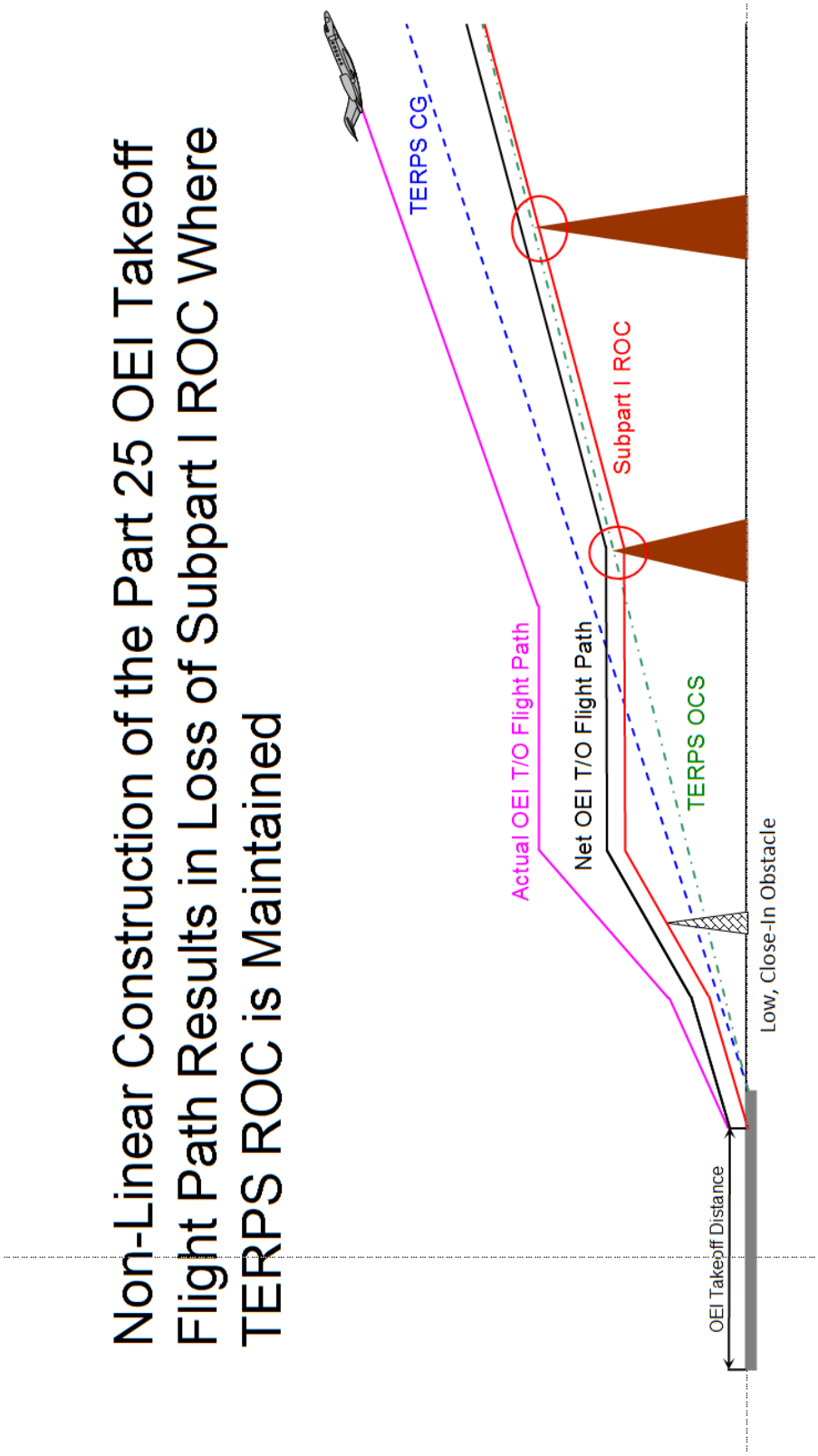


Fig 3

Low, Close-In Obstacle Example
Consideration of the TERPS 200 FPNM (3.3% CG) results in a takeoff weight greater than that allowed by an analysis performed in accordance with AC 120-91

TERPS Required CG = 200'/NM

HUTCHINSON, KS

HUTCHINSON MUNI

TAKE-OFF MINIMUMS: **Rwys 4,22,** 300-1 or std. with a min. climb of 370' per NM to 1700.
DEPARTURE PROCEDURE: **All Rwys,** eastbound departures (030° CW 130°) climb runway heading to 3300 before turning.

Subpart I 121/135 Airport Analysis

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RUNWAY            13
TORA(FT)            7004
TODA(FT)            7004
ASDA(FT)            7004
SLOPE(%)           -0.15
 TMP     N1- A/I
DEG C    OFF/ENG              LIMI

 28     84.4          36116 *O
 30     84.0          35856 *O
 32     83.6          35363 *O
 34     83.2          34870 *O
 36     82.8          34364 *O

 HW     +LBS/KT         76
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TAKEOFF SPEEDS AND BFL
S + 10° FLAPS

DRY RUNWAY
ANTI-ICE OFF

NO WIND
NO SLOPE

GW X 1000	DATA	2000 FT C -10 / F 14	0 / 32	10 / 50	20 / 68	30 / 86	40 / 104	V_R	V_2	V_{FR}	1.345 V_S	GW X 1000
36.5	BFL V1	5750 129	5950 129	6100 128	6350 128	6850 129	9050 129	129	132	143	169	36.5
36.0	BFL V1	5600 128	5800 128	6000 127	6200 127	6700 128	8550 128	128	131	141	168	36.0
35.8	BFL V1	5550 127	5750 127	5900 126	6150 126	6600 127	8350 128	128	130	140	167	35.8
35.0	BFL V1	5300 125	5500 125	5650 124	5850 124	6300 125	7750 127	127	129	139	165	35.0
34.0	BFL V1	5050 123	5200 123	5350 122	5550 122	5950 123	7050 125	125	127	137	163	34.0

NOTES: [shaded box] Will not make 3.3% gross climb gradient.

Revision 4

HUT Runway 13 Obstacles

RNWY	LENGTH	CLRWAY	STPWAY	SLOPE	END ELV	LND RWY	G.S.LGTH	ENT.ANGLE
13	7004	0	0	-0.15%	1515	7004	6101	90

OBST:	HT	DIST	HT	DIST	HT	DIST	HT	DIST	HT	DIST	HT	DIST
	5	636	7	669	42	979	0	0	0	0	0	0

Initial Discussion - MEETING 09-02: New issue presented by Rich Boll, NBAA. Advisory Circular (AC) 120-91, *Airport Obstacle Analysis,* was published in 2007 and is referred to by the AIM for guidance in developing one engine inoperative (OEI) procedures. AC 120-91 guidance is emphasized to operators under Part 121. However, Rich stated that NBAA is concerned that prior to the AC's release, many Part 135 operators and Part 142 training centers had developed ad hoc methods for takeoff obstacle avoidance based on complying with ODP or SID climb requirements under OEI. While this methodology may appear acceptable, it does not account for critical differences between TERPS criteria, Part 25 OEI takeoff certification rules, and the operating rules for OEI takeoff obstacle avoidance contained in the Part 135, Subpart I - see the full Recommendation Document above for additional details. NBAA is requesting the FAA notify operators and Part 142 training centers of the requirement to apply the performance data provided in the Airplane Flight Manual (AFM) using the procedures specifically described within the AFM when meeting the OEI takeoff obstacle avoidance rules of Subpart I, Part 121 or Part 135 as applicable. It must be further emphasized that the use of other procedures, techniques, or other work-arounds are **not** authorized unless specifically approved by the FAA. Further, Flight Standards should re-enforce that operators and training centers refer to AC 120-91 for guidance on OEI takeoff obstacle procedure development and alternative procedure approval. Since this guidance concerns regulatory compliance and safety, NBAA requests that it be published though a SAFO to all Part 135 operators and Part 142 training centers. Lastly, Rich recommended that the Instrument Procedures Handbook on IFR departures be expanded to include a discussion on OEI takeoff obstacle avoidance planning for airplanes subject to the 91.175(f)(4) requirements with specific reference to AC 120-91. Harry Hodges, AFS-420, briefed that he is the AFS representative to the Airport Obstruction Standards Committee (AOSC). The AOSC is not only looking at OEI surfaces, but also has initiated a pilot program at 5 airports under OE/AAA to try to develop a common surface for both TERPS and airport design standards. Official action has been tasked for the ATO, AVS, and Airports Division to work together to resolve differences. Roy Maxwell, Delta, added that the required policy guidance is already in place and supports the objective to provide notification and education to affected performance engineering organizations about the accurate application of the latest guidelines. Rich volunteered to lead a small ad hoc working group consisting of himself, Roy Maxwell, and representatives of AFS-200 and 400 to address the issue presented before the ACF-IPG. ACTION: NBAA.

MEETING 10-01: Rich Boll, NBAA, briefed that he has been working with Bruce McGray, AFS-410, and they have decided that the aircraft performance sub group that Bruce has proposed to address issue 98-01-197 will also address this issue. Mike Frank, AJT-28, asked why this issue wasn't being worked by AFS-210 and AFS-800. John Bollin, AFS-220, recommended Eric Friedman in AFS-210 as a POC for issues pertaining to training centers and participation in the sub group.
ACTION: NBAA and AFS-410.

MEETING 10-02: Rich Boll, NBAA, briefed that the AFS-410-NBAA Transport Airplane Performance Planning (TAPP) ad hoc working group formed under issue 98-01-197 is working the issue. The group will also address training requirements under Part 91.175(f) as well as air carrier climb gradient issues. The group met during the first week in June and proposed a web site with programs to help operators develop training material. Follow on meetings are planned with FAA, industry, and operators. It is hoped that 2 or 3 meetings will eliminate confusion surrounding the issue and allow the group to communicate all-engine performance requirements to manufacturers. Once these initial steps have been

taken, NBAA and Bombardier will sponsor a conference. Rich noted that actions have been on hold due to the illness of Bruce McGray, the AFS-410 representative. Mike Frank, AFS-52, asked why this group was working the issue instead of AFS-200. Rich responded that there are problems with FAA publishing procedures that pilots cannot comply with. Kevin Allen, USAIR, offered an example that arose at Philadelphia Intl (PHL). US Airways was involved in the GRDEN ONE SID design from the beginning. However, after the last meeting, there were some changes to the procedure at waypoint BRNDA. PHL TRACON moved the fix closer to the airport, kept the 9000' minimum altitude restriction and thus increased the climb gradient to 675'/nm. A heavy A-321 aircraft has performance limitations to 9000. FAA policy allows for a 500'/nm climb gradient before a waiver is required; however, in actuality, the A-321 will not make it at a much lower gradient. Kevin was not espousing a change to policy to accommodate the A-321; but emphasizing that required climb gradients must be carefully considered to accommodate all users of the procedure(s). Mike Frank emphasized that AFS-210 be involved in any work group addressing performance issues. John Blair, AFS-410, recommended that this issue and issue 98-01-197 be combined. Bill Hammett, AFS-420 (ISI) responded that although the issues were similar in nature, they would remain separate. Past history has proven that combined issues take on a life of their own. The issues may be worked together, but will be tracked separately. ACTION: AFS-410 and NBAA.

MEETING 11-01: Bruce Mc Gray, AFS-410, briefed that this issue is being worked jointly with 98-01-197; however, it has been a difficult year to make progress on either issue . He had significant health problems and the Division lost its subject matter expert for Part 25 and 91K users. Bruce has been working with Rich Boll, NBAA, and Roy Maxwell, Delta, to expand the scope of the issues. He and Rich are trying to schedule a conference between FAA and industry concerning aircraft performance in the January-March 2012 timeframe. It is hoped that this conference will define the issue and develop the necessary training program. Bruce recommended this issue also be placed on temporary hold pending this conference; the Chair agreed. ACTION: AFS-410 and NBAA.

MEETING 11-02: Rich Boll, NBAA, briefed that the AFS-410 - NBAA Transport Airplane Performance Planning (TAPP) Working Group is jointly addressing this issue and issue 98-01-197 with a goal of identifying and addressing applicable guidance materials necessary to inform pilots of the operational issues. The group met on August 30 and October 24 and has drafted language for Change 3 to FAA Order 8900.10 that will clarify guidance for inspectors regarding take-off obstacle rules. They have also queried the Society of Aircraft Performance and Operations Engineers (SAPOE) to look into airport data acquisition and reporting methodology and provide recommendations on changes and additional information that may be required. The group had hoped to have better progress on the issue of having manufacturers provide all engine climb data, but that issue is lagging. JD Hood, Verizon Air, requested a synopsis of the issue, which Rich provided. Ted Thompson, Jeppesen, re-iterated that many departure procedures have climb gradients, but the pilot has no way of knowing whether the aircraft can meet those gradients Rich added that once the performance data is known, the next step is how can we show the data that the aircraft can meet the climb gradient. Roy Maxwell, Delta, agreed stating that early on in a departure, the pilot has no way of knowing whether the aircraft can meet the specified climb gradient over the earth. Kel Christianson noted that there has been no additional discussion by the PARC on this issue and AFS-400 is considering whether to request the PARC re-address the issue. The issue will remain open to be addressed by the TAPP. ACTION: AFS-410 and NBAA.

MEETING 12-01: Bruce McGray, AFS-410, provided a briefing on the AFS-410-NBAA Transport Airplane Performance Planning (TAPP) Working Group's progress in addressing this issue and issue 09-02-287 (A copy of Bruce's slide presentation is included here). The primary goals of the TAPP are: 1) to provide updated guidance material and enhanced job aids for operators and inspectors; 2) to improve operator and inspector knowledge of OEI performance planning; and, 3) to improve inspector and Part 142 training of Part 25 performance planning requirements. Bruce briefed that the group is making progress in addressing the issue through OpSpec C46. He added that the TAPP will be increasing awareness by making presentations at the October NBAA conferences as well as the upcoming Bombardier conference. Bob Lamond, NBAA, interjected that it is not too early to make reservations for the NBAA conference now. Steve Serur, ALPA, asked if any progress is being made on getting information from aircraft manufacturers. Bruce replied that this issue has been identified as a problem and is being addressed. Roy Maxwell, Delta, stated that the problem is data. Twenty years ago, there was none; today, we have too much. There are computers today that will assess performance, but require many data inputs. the effort should be to simplify requirements to coincide with current information. Rich agreed that data is an issue; however, the climb profile must be known. On a second IOU for the issue, Bill Hammett, AFS-420 (ISI), asked whether a decision had been made by AFS-470 to re-engage the PARC on OEI procedures. Mark Steinbicker, AFS-470, responded that the PARC has no interest in pursuing OEI issues at this time. ACTION: AFS-410 and NBAA.

MEETING 12-02: Bruce McGray, AFS-410, provided a briefing on the joint AFS-410-NBAA Transport Airplane Performance Planning (TAPP) Working Group's progress in addressing this issue and related issue 98-01-197 (A copy of Bruce's slide presentation is included here). Bruce reported that excellent progress has been made on this issue over the past seven months. Through the cooperation of FAA, NBAA, Boeing, Delta Airlines, Bombardier, and others, a 40 minute video presentation demonstrating the aircraft performance limitations and proposing solutions was made and presented at the Bombardier Safety Stand Down Forum. The video is the first in a planned series of modules to promote understanding of aircraft performance, both with all engines operating and in the event of one engine inoperative (OEI). The subject area involved guidance and educational materials related to take-off obstacle analysis, OEI planning, and guidance for pilots of transport aircraft. The scope of recent activity was expanded to include business transport aircraft operating under 14 CFR Part 91. The goal is improved knowledge and understanding of aircraft performance. Specific subject areas include:

Understanding of declared distances	Wet runway take-off performance
Landing distance assessments	Departure planning
SID climb gradients & OEI planning	OEI departure procedures

It is hoped the video is useful for both airline and corporate/business operators. The video was well received by the Bombardier participants and will also be presented at the NBAA 2012 Convention later this month. The TAPP is also coordinating with the FAA on how to share and distribute relevant material. Bruce also added that the key to a permanent solution is improving the training provided by Part 142 facilities. To this end FAA Flight Standards is standing up the first Certificate Management Office (CMO) for Part 142 Training Facilities. Bruce closed by expressing that he has never seen such FAA-industry cooperation as he witnessed during the preparation of the video. He publically acknowledged both specific individuals and corporations by name. Tom Schneider questioned whether the completion of the video satisfies the original issue objectives when submitted by ALPA back in 1998. Bob Lamond, NBAA, responded that with the ongoing

activities of the TAPP, he felt this issue and related issue 98-01-197 could be closed. The representatives from ALPA did not object and Bruce McGray, AFS-420, also supported closure through the ACF emphasizing that the issue would continue to be of FAA interest through the TAPP. The group agreed. Item CLOSED
